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TRANSLATOR'S DECLARATION: August 20, 2007

I, Carl Sullivan, hereby declare:

That I possess advanced knowledge of the Korean and English languages. The attached translation of **"Application Number 10-2003-0008141"** has been reviewed by me and to the best of my knowledge and belief, it accurately reflects the meaning and intention of the original text.

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Korean Intellectual Property Office

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Applicant: SAMSUNG TECHWIN CO., LTD.

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[Abstract of the Disclosure]

[Abstract]

A method of controlling a digital camera includes performing photographing of an object, determining whether the amount of exposure is appropriate and shakiness is present, and notifying a user of such information if the amount of exposure is not appropriate or shakiness is present. The determination step includes reading a focus value of the object, reading a lower limit value of a compressed file size set to correspond to the read focus value of the object at a compression rate and a resolution set by the user, and determining that the amount of exposure is not appropriate and shakiness is present if the size of a present compressed file of image data obtained from the photographing is smaller than the lower limit value of the compressed file size.

[Specification]

[Name of the Invention] Control method of digital camera informing that photographing state was inadequate

[Brief Explanation of the Drawings]

Drawing 1 shows a working example of the digital camera of the present invention

Drawing 2 shows a rear view of the digital camera of Drawing 1

Drawing 3 shows a block view of the overall composition of the digital camera of Drawing 1

Drawing 4 shows the flow indicating the overall control algorhythm of the microcontroller of Drawing 3

Drawing 5 shows the flow indicating the detailed algorhythm of the photographic step of Drawing 4

Drawing 6 shows the detailed flow indicating each algorhythm relative to exposure and shake conditions of the algorhythms of Drawing 5

Drawing 7a shows the graph indicating the relationship of the size of compressability and compression waves

Drawing 7b shows the graph indicating the relationship of the size of resolution and compression waves

Drawing 8 shows graph indicating the trend line and bottom line to set the bottom price for the size of the compression waves corresponding to the focal point

<code explanation of important portions of the drawings>

1. digital camera	11. self timer lamp
12. flash	13. shutter button
14. mode dial	15. function-selection button

16. camera information display part
17.a, 17b viewfinder
18. function-block button
19. flash light sensor
21. web interface part
21a. USB port
21b. RS232C port
21c. video output part
35. color LCD panel
31. power button
32. monitor button
33. automatic focal lamp
34. flash lamp
36. confirmation/cancellation button
37. enter/playback button
38. menu button
39w. wide angle/zoom button
39t. tele-zoom lens
40up. upward-movement button
40ri. right-movement button
41lo. downward-movement button
40le. left-movement button
50l. analog-digital conversion part
502. timing circuit
503. clock
504. DRAM
505. EEPROM
506. memory card interface
507. digital signal processor
508. RS232C interface
509. video filter
510. lens drive part
511. flash controller
512. microcontroller
513. audio processor
514. LCD drive part
MIC. Microphone
SP speaker

OPS. optical system OEC. photoconversion part

MZ. zoom motor MF. focus motor

MA. aperture motor INP user input part

LAMP. Illumination part

[Detailed Explanation of the Invention]

[Purpose of the Invention]

[Industrial Field of the Application and Prior Art]

The present invention relates to a method of controlling a digital camera, and more particularly, to a method of controlling a digital camera in which digital image data is generated by photographing and the image data is stored in a recording medium.

Typical digital cameras, for example, a digital camera having a model name "Digimax 350SE" which is manufactured by Samsung Techwin Co., Ltd., does not have a function to inform a user of inadequate photography after the user takes a photograph. Of course, most typical digital cameras have a function in which the user reviews a photograph as soon as he/she takes the photograph. For example, when the user takes a photograph, an image obtained through the photographing is displayed on a display device. However, most users do not realize that the present photographing was performed inadequately through the above function; moreover, users do not use this function, which is inconvenient. Thus, with typical digital cameras, when a user inadequately performs photographing, he/she does not know that an inadequate photograph was taken so that he/she may again take the photograph.

[Technical Problem that the Invention is to Solve]

To solve the above and/or other problems, the present invention provides a method of controlling a digital camera capable of informing a user of inadequate photographing so that the user can perform photographing again.

[Constitution and Effects of the Invention]

According to an aspect of the present invention, a method of controlling a digital camera comprising performing photographing of an object, determining whether the amount of exposure is appropriate and shakiness is present, and notifying a user of such information if the amount of exposure is not appropriate or shakiness is present, wherein the determination step comprises reading a focus value of the object, reading a lower limit value of a compressed file size set to correspond to the read focus value of the object at a compression rate and a resolution set by the user, and determining that the amount of exposure is not appropriate and shakiness is present if the size of a present compressed file of image data obtained from the photographing is smaller than the lower limit value of the compressed file size.

Assuming that X is the focus value of the object, N is the number of samples, X_i is the focus value of an i-th sample, Y_i is the size of a compressed file size of the i-th sample at the compression rate and resolution set by the user, a is

$$\frac{\left(\sum_{i=1}^{N} X_i\right)\left(\sum_{i=1}^{N} Y_i\right)-N\left(\sum_{i=1}^{N} X_i Y_i\right)}{\left(\sum_{i=1}^{N} X_i\right)^2-N\left(\sum_{i=1}^{N} X_i^2\right)}$$

, and b is

$$\frac{\left(\sum_{i=1}^{N} Y_i\right)\left(\sum_{i=1}^{N} X_i^2\right)-N\left(\sum_{i=1}^{N} X_i\right)\left(\sum_{i=1}^{N} X_i Y_i\right)}{N\left(\sum_{i=1}^{N} X_i^2\right)-\left(\sum_{i=1}^{N} X_i\right)}$$

, the lower limit value of the compressed file size is set as k(aX+b) in which 0<k<1, wherein k is 07 through 0.8.

Below, the preferred embodiments of the present invention are described in detail with reference to the attached drawings in which:

FIG. 1 is a perspective view illustrating a digital camera according to a preferred embodiment of the present invention; FIG. 2 is a rear view illustrating the digital camera of FIG. 1; FIG. 3 is a block diagram illustrating the overall structure of the digital camera of FIG. 1.

Referring to FIG. 1, a microphone MIC, a self-timer lamp 11, a flash 12, a shutter button 13, a mode dial 14 a function selection button 15, a photographing information display portion 16, a viewfinder 17a, a function block button 18, a flash light amount sensor 19, a lens portion 20, and an external interface portion 21 are provided in the front and upper surfaces of a digital camera 1 according to a preferred embodiment of the present invention.

The self-timer lamp 11 flickers in a self-timer mode during a set time after the shutter button 13 is pressed until the photographing starts. The mode dial 14 is used for a user to set a variety of modes, for example, a still image photographing mode, a night view photographing mode, a motion picture photographing mode, a reproduction mode, a computer connection mode, and a system setting mode. The function selection button 15 is used for the user to select one of operational modes of the digital camera 1, for example, the still image photographing mode, the night view photographing mode, the motion picture photographing mode, and the reproduction mode. The photographing information display portion 16 displays information of the respective functions related to photographing. The function block button 18 is used for the user to select each function displayed on the photographing information display portion 16.

Referring to FIG. 2, a speaker SP, a power button 31, a monitor button 32, an auto-focus lamp 33, a viewfinder 17b, a flash ready lamp 34, a display panel 35, a confirm/delete button 36, an enter/play button 37, a menu button 38, a wide angle zoom button 39w, a telephoto zoom button 39t, an up movement button 40up, a right movement button 40ri, a down movement button 40lo, and a left movement button

40le are arranged on the rear side of the digital camera 1 according to the present invention.

The monitor button 32 is used to control the operation of the display panel 35. For example, when the monitor button 32 is first pressed, an image of an object pictured and photographing information thereof are displayed on the display panel 35. When the monitor button 32 is second pressed, only an image of the pictured object is displayed on the display panel 35. When the monitor button 32 is third pressed, power applied to the display panel 35 is cut off. The auto-focus lamp 33 is operated when an input image is well focused. The flash ready lamp 34 is operated when the flash 12 of FIG. 1 is in a ready mode. The confirm/delete button 36 is used as a confirm button or a delete button in the process in which the user sets each mode. The enter/play button 37 is used for the user to input data or for the function of stop or reproduction in a reproduction mode. The menu button 38 is used to display menu of a mode selected by the mode dial 14. The up movement button 40up, the right movement button 40ri, the down movement button 40lo, and the left movement button 40le are used in the process in which the user sets each mode.

The overall structure of the digital camera of FIG. 1 is described below with reference to FIG. 3.

An optical system OPS including a lens portion and a filter portion optically processes light from an object to be photographed. The lens portion in the optical system OPS includes a zoom lens, a focus lens, and a compensation lens.

An optoelectric converting portion OEC of a charge coupled device (CCD) or complementary metal-oxide-semiconductor (CMOS) converts light from the optical system OPS to an electric analog signal. Herein, digital signal processor (DSP) 507 controls timing circuit 502, as well as the operation of the OEC and an

analog-to-digital converting portion. A correlation double sampler and analog-to-digital converter (CDS-ADC) device 501 as the analog-to-digital converting portion processes an analog signal from the optoelectric converting portion OEC to remove a high frequency noise and adjust amplitude thereof, and converts the processed analog signal to a digital signal. The DSP 507 generates a digital image signal classified by brightness and chromaticity signals, by processing the digital signal from the CDS-ADC device 501.

The digital image signal from the DSP 507 is temporarily stored in a DRAM 504. The algorithm and set data needed for the operation of the DSP 507 is stored in an EPROM 505. A memory card of a user is inserted in or detached from a memory card interface 506.

A digital image signal from the DSP 507 is input to a LCD driving portion 514 so that an image is displayed on the color LCD panel 35.

The digital image signal from the DSP 507 can be transmitted through a USB (universal serial bus) connection portion 21a and an RS232C interface 508 and a connection portion 21b thereof, as a serial communication, and a video filter 509 and a video output portion 21c, as a video signal.

An audio processor 513 outputs a voice signal from a microphone MIC to the DSP 507 or the speaker SP and outputs an audio signal from the DSP 507 to the speaker SP.

The user input portion INP includes the shutter button 13 of FIG. 1, the mode dial 14 of FIG. 1, the function selection button 15 of FIG. 1, the function block button 18 of FIG. 1, the monitor button 32 of FIG. 2, the confirm/delete button 36 of FIG. 2, the enter/play button 37 of FIG. 2, the menu button 38 of FIG. 2, the wide angle zoom button 39w of FIG. 2, the telephoto zoom button 39t of FIG. 2, the up

movement button 40up of FIG. 2, the right movement button 40ri of FIG. 2, the down movement button 40do of FIG. 2, and the left movement button 40le of FIG. 2.

The microcontroller 512 controls the lens driving portion 510 and accordingly the zoom motor M_Z, the focus motor M_F, and the aperture motor M_A respectively drive the zoom lens, the focus lens, and the aperture in the OPS. A light emitting portion LAMP driven by the microcontroller 512 includes the self-timer lamp 11, the auto focus lamp 33, and a flash ready lamp 34. The microcontroller 512 controls the operation of the flash controller 511 according to the signal from the flash light amount sensor 19.

In the control algorithm of the microcontroller 512, after photographing is performed according to the operation by the user, the image data obtained from the photographing operation is analyzed by the DSP 507 to determine whether the amount of exposure is appropriate and shakiness is present. If it is determined that the amount of exposure is not appropriate or shakiness is present, the user is notified of the information, which will be described below.

FIG. 4 shows the overall control algorithm of the microcontroller 512 of FIG. 3.

Referring to FIG. 4, whether a photographing mode is set is determined in Step S1. When the photographing mode is set, the microcontroller 512 performs a photographing control step S1. Whether a menu mode is set is determined in Step S3. When the menu mode is set, the microcontroller 512 performs a setting control step S4 to set operational conditions of a camera. In Step S5, the above steps are repeated until an external end signal is input.

FIG. 5 shows a detailed algorithm of the photographing control step S2 of FIG. 4. The shutter button 13 included in the user input portion INP has a two-step structure. That is, when a user presses the shutter button 13 to the first step after

operating the wide angle zoom button 39w or telephoto zoom button 39t, a signal S1 from the shutter button 13 is turned on and, when the user presses the shutter button 13 to the second step, a signal S2 from the shutter button 13 is turned on. Thus, the photographing control algorithm of FIG. 5 starts when the user presses the shutter button 13 to the first step (Step 601).

Referring to FIGS. 3 and 5, in the algorithm of the photographing control (Step S2 of FIG. 5), when the signal S1 is turned on (Step 601), the remaining capacity of the memory card is checked (Step 602). Then, it is determined whether the remaining capacity of the memory card is sufficient for recording a digital image signal (Step 603). If the remaining capacity is not sufficient for recording, a message indicating the capacity of the memory card is not sufficient is displayed (Step 604).

If the remaining capacity is sufficient for recording, first, an automatic white balance (AWB) mode is performed to set related parameters (Step 605). Next, an automatic exposure (AE) mode is performed so that the amount of exposure with respect to incident luminance is calculated. Then, the aperture drive motor M_A is driven according to the calculated exposure amount (Step 606). Next, an automatic focusing mode (AF) mode is performed, the present position of the focus lens FL is set (Step 607).

Next, whether the signal S1 that is a first step signal from the shutter button 13 is in an "ON" state is determined (Step 608). If the signal S1 is not in the "ON" state, since the user does not have an intention to take a photograph, the execution program is terminated. If the signal S1 is in the "ON" state, it is determined whether the signal S2 is in the "ON" state (Step 609). If the signal S2 is not in the "ON" state, since the user does not press the second step of the shutter button 13 to take a photograph, the execution program is moved to Step 606.

If the signal S2 is in the "ON" state, since the user presses the second step of the shutter button 13 to take a photograph, a photographing operation is performed (Step 610). That is, the microcontroller 512 operates the DSP 507 so that the optoelectric converting portion OEC and the CDS-ADC device 501 are operated by the timing circuit 502. Next, image data is converted and compressed by the digital signal processor 507. The compressed image file is stored in the memory card

through the memory card interface 506.

Next, the image data obtained form the photographing is analyzed by the DSP 507 so that the appropriateness of the amount of exposure and the presence of shakiness are determined. If it is determined that the amount of exposure is inappropriate and shakiness is present, the user is notified of the information (Step 611)

FIG. 6 is a flow chart for explaining the algorithm of the exposure and shakiness state checking step (Step 611) of FIG. 5. FIG. 7A is a graph showing the relationship between a compression rate and a compressed file size. FIG. 7B is a graph showing the relationship between a resolution and a compressed file size. FIG. 8 is a graph showing a trend line and a lower limit line for setting a lower limit value of the compressed file size corresponding to a focus value. Referring to FIGS. 6 through 8, the algorithm of the exposure and shakiness state checking step (Step 611 of FIG. 5) is described as follows.

First, a focus value with respect to an object is determined (Step 611a). The focus value is defined as a sum of high frequency component values of an image. The high frequency component value of an image is a component in which a change in a gray level is rapid with respect to a boundary of the object when the image is represented by brightness only, not by color, that is, by a gray image. In contrast, a low frequency component of an image is a component in which a change in the gray level is gradual. In a typical automatic focusing (AF) method, the sum of high frequency component values is calculated with respect to the boundary of the object while moving a focus lens FL and a position of the focus lens FL when the sum is maximum is determined as a focused position. The reason for focusing in the above method is because a clear image which is focused has a large amount of the high frequency component whereas an unclear image which is not focused has a small amount of the high frequency component and a large amount of low frequency component. As a result, the focus value is obtained by summing the high frequency component values of an image. Thus, the focus value is determined when an automatic focusing mode is performed prior to photographing the object.

Next, when the focus value to the object is smaller than a lower limit value, since reliability in determination is deteriorated by external factors such as image noise, the program is terminated (Step 611b).

When the focus value to the object is greater than a lower limit value, the lower limit value of a compressed file size which is set corresponding to the focal value of the object determined from the compression rate and resolution set by the user is determined (Step 611c). In terms of the definition of a focus value, an image having a high complexity due to many boundaries has a great focus value before photographing and the size of a compressed file of the photographed image data increases. In other words, when photographing is performed normally without a problem in the shakiness or exposure, the focus value before photographing and the size of a compressed file of the photographed image data is proportional to each other. Thus, when a factor lowering the complexity of an image such as shakiness or overexposure/underexposure occurs during capturing the image before photographing after the photographing control step (Step S2), the actual size of a compressed file is smaller than the normal size of a compressed file corresponding to the focus value read before the photographing control step (Step S2) after the photographing mode determination step (Step S1). The size of a compressed file of the photographed image data varies according to the compression rate and resolution set by the user. The size of a compressed file of the photographed image data is in inverse proportion to the compression rate as shown in FIG. 7A and in proportion to the resolution as shown in FIG. 7B. Thus, the size of a compressed file of the photographed image data must be set in consideration of the compression rate and resolution set by the user. A method of setting a lower limit value of the compressed file size corresponding to the focus value before photographing using the above feature is described as follows.

As shown in FIG. 8, a trend line of a compressed file size corresponding to a focus value is obtained through tests to samples. Assuming that X is the focus value of an object, Y is the trend value of the compressed file size, N is the number of samples, X_i is the focus value of the i-th sample, and Y_i is the compressed file size of the i-th sample at the compression rate and resolution set by a user, the trend line can be determined according to Equation 1.

[Equation 1] $Y = aX + b$, wherein

$$a = \frac{\left(\sum_{i=1}^{N} X_i\right)\left(\sum_{i=1}^{N} Y_i\right) - N\left(\sum_{i=1}^{N} X_i Y_i\right)}{\left(\sum_{i=1}^{N} X_i\right)^2 - N\left(\sum_{i=1}^{N} X_i^2\right)}, \text{ and } b = \frac{\left(\sum_{i=1}^{N} Y_i\right)\left(\sum_{i=1}^{N} X_i^2\right) - N\left(\sum_{i=1}^{N} X_i\right)\left(\sum_{i=1}^{N} X_i Y_i\right)}{N\left(\sum_{i=1}^{N} X_i^2\right) - \left(\sum_{i=1}^{N} X_i\right)}$$

When the trend Y of the compressed file size corresponding to the read focus value X of the object at the compression rate and resolution by the user is determined, the lower limit value Y_i of the compressed file size is set with respect to the trend value Y. The lower limit value Y_i of the compressed file size is preferably set to be between 7% through 80% of the trend value Y, which can be expressed as in Equation 2.

[Equation 2]

$Y_L = kY = k(aX-b)$, wherein k=0.7-0.8

After the lower limit value Y_L of the compressed file size set corresponding to the read focus value X of the object is obtained from Equation 2, if the present compressed file size of the image data obtained from photographing is smaller than the lower limit value of the set compressed file size, a message indicating that there may be a problem in the shakiness and the exposure is displayed (Steps S611d and S611e).

[Effects of the Invention]

As described above, in the method of controlling a digital camera according to the present invention, the user is immediately notified of the presence of problems of exposure and shakiness shortly after photographing and can perform photographing again.

While this invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that

various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

[Claims]

[Claim 1] A method of controlling a digital camera comprising:

performing photographing of an object;

determining whether the amount of exposure is appropriate and shakiness is present; and

notifying a user of such information if the amount of exposure is not appropriate or shakiness is present,

wherein the determination step comprises:

reading a focus value of the object;

reading a lower limit value of a compressed file size set to correspond to the read focus value of the object at a compression rate and a resolution set by the user; and

determining that the amount of exposure is not appropriate and shakiness is present if the size of a present compressed file of image data obtained from the photographing is smaller than the lower limit value of the compressed file size.

[Claim 2] The method as claimed in claim 1, wherein, assuming that X is the focus value of the object, N is the number of samples, X_i is the focus value of an i-th sample, Y_i is the size of a compressed file size of the i-th sample at the compression rate and resolution set by the user, a is $\frac{\left(\sum_{i=1}^{N} X_i\right)\left(\sum_{i=1}^{N} Y_i\right)-N\left(\sum_{i=1}^{N} X_i Y_i\right)}{\left(\sum_{i=1}^{N} X_i\right)^2-N\left(\sum_{i=1}^{N} X_i^2\right)}$, and b is

$\frac{\left(\sum_{i=1}^{N} Y_i\right)\left(\sum_{i=1}^{N} X_i^2\right)-N\left(\sum_{i=1}^{N} X_i\right)\left(\sum_{i=1}^{N} X_i Y_i\right)}{N\left(\sum_{i=1}^{N} X_i^2\right)-\left(\sum_{i=1}^{N} X_i\right)}$, the lower limit value of the compressed file size is set as k(aX+b) in which 0<k<1.

[Claim 3] The method as claimed in claim 2, wherein k is 07 through 0.8.